

## Assignment 6 Cross Sections

1. Arie van Wijngaarden shoots a puck at his goaltender father. Arie stands 30 meters from a net having dimensions 3 meters x 2 meters. Assuming his father obscures 1/3 of the net, what is the solid angle of open net?
2. An experimentalist wishes to probe the nucleus which can be approximated as a hard sphere having a radius of  $10^{-13}$  cm. How large must the probe beam intensity be if the target consists of  $10^{10}$  nuclei and the total scatter rate is to be an order of magnitude larger than the background noise of  $10^3$  counts/sec?
3. A beam having a flux of  $10^{10}$  particles per second per  $\text{cm}^2$  is incident on a target. The differential cross section is  $d\sigma/d\Omega = b^2 (\sin \phi)^2$ 
  - a) What is the total cross section?
  - b) What is the value of b if the total number of scattered particles into  $4\pi$  steradians is  $10^8$  particles per second?
  - c) How is your answer in part(b) affected if the beam flux is  $10^{16}$  particles per second per  $\text{cm}^2$  and the total scatter rate is  $10^8$  particles/sec?
4. A fixed force center scatters a particle of mass m according to the force law  $F(r) = +k/r^3$ . If the initial velocity of the particle is  $u_0$  show that the differential scattering cross section is

$$\sigma(\theta) = \frac{k \pi^2 (\pi - \theta)}{m u_0^2 \theta^2 (2\pi - \theta)^2 \sin \theta}$$